PATENT ABSTRACTS OF JAPAN

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(21)Application number : 10-007740

(22)Date of filing : 19.01.1998

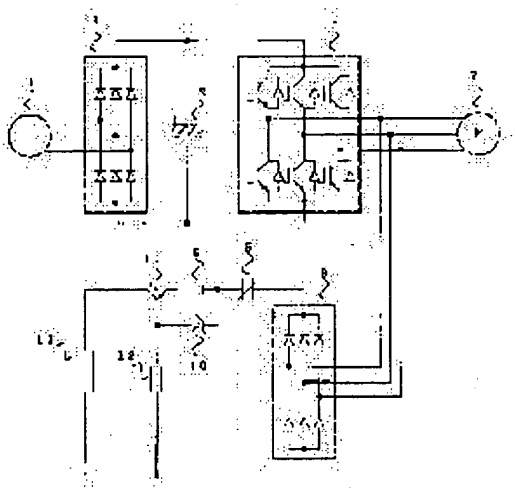
(71)Applicant : OKUMA CORP

(72)Inventor : ADACHI MITSUAKI
MORI KOJI

(54) INVERTER CONTROL EQUIPMENT

(57)Abstract:

PROBLEM TO BE SOLVED: To linearly decrease speed of a servomotor and reduce a damping distance, by installing a previously set constant current control part in a DC output of a motor regenerative power conversion part, which isolates a DC power source part from an inverter and converts AC power regenerated from a motor to DC power.



SOLUTION: This inverter control equipment consists of an inverter 1, a smoothing capacitor 2, diode bridges 3, 8, a three-phase AC power source 4, a contact 5 for break, a servomotor 7 and a constant current circuit constituted of a transistor 11, resistors 9, 12, 13 and a Zener diode 10. A control current of the servomotor 7 is controlled to be a previously set value of the constant current circuit. In the case except emergency brake, the contact is opened and the constant current circuit does not operate. In the case of emergency break, the smoothing capacitor 2 is isolated from the inverter 1, and the contact is closed. Regenerated AC power is converted to DC power by the bridge 8, consumed in the constant current circuit, and the number of revolution of the motor 7 is linearly decreased.

LEGAL STATUS

[Date of request for examination] 27.03.2002

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[Date of final disposal for application]

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[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention carries out adjustable control of the motor, and relates to the control device in the case of carrying out the emergency stop especially of the servo motor about the inverter control device used for a machine tool, a robot, etc.
[0002]
[Description of the Prior Art] Drawing 5 shows an example of the conventional inverter control unit. this example -- setting -- 1 -- for a diode bridge and 4, as for the contact for dynamic brake of B contact structure, and 6, a three-phase-alternating-current power source and 5 are [a smoothing capacitor, and 3 and 8 / an inverter and 2 / dynamic brake resistance and 7] servo motors. Moreover, although not illustrated, it lets the device of a gear, a ball screw, etc. pass to a servo motor 7, and the table of a machine tool, a robot's arm, etc. are connected with it.
[0003] In order to rotate a servo motor 7 from a idle state, power is supplied to a servo motor 7 through an inverter 1 from a smoothing capacitor 2. On the contrary, in order to stop a servo motor 7 from a rotation condition, power is revived from a servo motor 7 to a smoothing capacitor 2 through an inverter 1. At this time, the contact 5 for dynamic brake is in an open condition.
[0004] When carrying out the emergency stop of the servo motor 7, while separating a smoothing capacitor 2 and an inverter 1 electrically with the means which is not illustrated here, the contact 5 for dynamic brake is made into a closed state, a servo motor 7, a diode bridge 8, and the dynamic brake resistance 6 are connected, after changing into direct current power the alternating current power revived from a servo motor 7 in a diode bridge 8, by the dynamic brake resistance 6, it changes into heat, and consumes, and a servo motor 7 is stopped.
[0005] In the above conventional inverter control devices, when carrying out the emergency stop of the servo motor 7, the rotational frequency N (t) of the Current ib (t) and the servo motor 7 which flow to the dynamic brake resistance 6, and the **** distance D are expressed by the approximate expression shown in the one following, several 2, and several 3, respectively.
[Equation 1] ib(t) =KvxN(t) xe(-60 KvKtxt/(2piJR))/R -- [Equation 2] N(t) =Nxe (-60 KvKtxt/(2piJR))/60 -- [Equation 3] D=(N/60) x (2piJR/(60KvKt))
However, for a motor rating rotational frequency and Kv, an induced voltage constant and Kt are [N / Rota inertia + motor shaft conversion load inertia and R of a torque constant and J] root3x (internal resistance + dynamic brake resistance of a motor).
Here, it will be set to (A) of drawing 6 , and (B) if several 1 and several 2 relation is illustrated. As shown in several 1 and drawing 6 (A), in order that the current ib which flows to the dynamic brake resistance 6 may decrease exponentially, the engine speed N of a servo motor 7 decreases exponentially, consequently the phenomenon stopped across the location which must carry out an emergency stop generates a servo motor 7.
[0006]
[Problem(s) to be Solved by the Invention] in a Prior art, since [to which the rate of a servo motor 7 decreases] it was alike, and it followed and the speed electromotive force of a servo motor 7 also declined, the braking current which flows to the dynamic brake resistance 6 could not be kept constant, consequently there was a problem that the brake stopping distance of a servo motor 7 became long. This invention is made from the above situations, and it is alike, therefore the speed electromotive force of a servo motor 7 also declines, and since the purpose of this invention cannot keep constant the braking current whose rate of a servo motor 7 decreases and which flows to the dynamic brake resistance 6, it is to offer the means for solving the problem that the brake stopping distance of a servo motor 7 becomes long.

[0007]
[Means for Solving the Problem] This invention relates to the inverter control unit which carries out adjustable control of the motor. The above-mentioned purpose of this invention While separating the DC-power-supply section which supplies direct current power to an inverter from said inverter in the regenerative-control circuit which performs power control at the time of moderation of said inverter control device It is attained by preparing the motor regeneration power conversion section which changes into a direct current the alternating current power revived from said motor, and the constant current control section which carries out energization control according to the direct-current constant current which was connected to the dc output of said motor regeneration power conversion section, and was set up beforehand. Moreover, instead of said constant current control section, it connects with the dc output of said motor regeneration power conversion section, and the above-mentioned purpose is attained also by preparing the regeneration resistance section which carries out a connection change by the delayed relay, combining two or more power regeneration resistance gradually.
[0008]
[Embodiment of the Invention] Drawing 1 makes the first example of this invention correspond to drawing 5 , and shows it. This example controls the braking current of a servo motor 7 by the current regulator circuit which consists of a transistor 11, resistance 9, 12, and 13, and zener diode 10 to the value set up beforehand instead of the dynamic brake resistance 6 in the conventional inverter control device shown in drawing 5 .
[0009] The principle of operation of this circuit is as follows. In the condition other than an emergency stop, the contact 5 for dynamic brake is in an open condition. For this reason, a current regulator circuit does not operate. Next, if an emergency stop command is outputted, while separating a smoothing capacitor 2 and an inverter 1 electrically with the means which is not illustrated, the above-mentioned contact 5 for dynamic brake will be in a closed state, and after the alternating current power revived from a servo motor 7 is changed into direct current power in a diode bridge 8, it is consumed in a current regulator circuit.
[0010] Here, a different point from the conventional control unit is as follows. Although it decreases exponentially as the current ib which flows to the dynamic brake resistance 6 conventionally is shown by several 1 and drawing 6 (A), in this control device, the fixed current decided by the difference of the zener voltage of zener diode 10 and the electrical potential difference between base-emitters of PNP transistor 11 and the resistance of resistance 9 flows. Therefore, the output torque of a servo motor 7 becomes fixed, and since it decreases linearly as shown in drawing 2 (B), the rotational frequency N can shorten sharply the **** distance D of the servo motor 7 after an emergency stop command is outputted until it stops as compared with the conventional control unit.
[0011] Moreover, drawing 3 is made to correspond to drawing 5 , and the 2nd example of this invention is shown in it. This example is connected to the dynamic brake resistance 6 from which resistance differs, respectively, 6-1, and 6-2 in the conventional servo motor control device shown in drawing 5 , after an emergency stop command is outputted, the contact 5-1 for dynamic brake will be in a closed state after time amount t1 progress, and then, the contact 5-2 for dynamic brake will be in a closed state after time amount t2 progress. Consequently, the rotational frequency N of the Current ib and the servo motor 7 which flow to the dynamic brake resistance 6, 6-1, and 6-2 decreases like the thick wire shown in drawing 4 (A) and (B), respectively.
[0012] In addition, the above-mentioned contact 5-1 for dynamic brake and the timing time amount t1 and t2 which makes 5-2 a closed state The current which flows to the dynamic brake resistance 6-1 and 6-2 with the current detection equipment which detects the timer circuit which is not illustrated and the current which flows to a servo motor 7, and which is not illustrated is detected. When it becomes below a certain defined level, the above-mentioned contact 5-1 for dynamic brake and a means to make 5-2 into a closed state can be considered. Thus, according to the 2nd example, the **** distance D of a servo motor 7 can be shortened rather than the conventional example.
[0013] In addition, although **** explained the servo motor, it is applicable similarly about other motors. Moreover, the contact for dynamic brake may be an electronic switching circuit also in Mechanical contacts, such as a relay.
[0014]
[Effect of the Invention] Conventionally, when the emergency stop of the servo motor was carried out, in order that the rate and speed electromotive force of a servo motor might decrease exponentially, the braking current which flows to dynamic brake resistance also decreased exponentially, as a result, the **** distance of a servo motor became long, but since according to this invention it controls so that the braking current which flows to dynamic brake resistance becomes fixed, the rate of a servo motor decreases linearly and the **** distance of a servo motor can be shortened.

[Translation done.]

MEANS

[Means for Solving the Problem] This invention relates to the inverter control unit which carries out adjustable control of the motor. The above-mentioned purpose of this invention While separating the DC-power-supply section which supplies direct current power to an inverter from said inverter in the regenerative-control circuit which performs power control at the time of moderation of said inverter control device It is attained by preparing the motor regeneration power conversion section which changes into a direct current the alternating current power revived from said motor, and the constant current control section which carries out energization control according to the direct-current constant current which was connected to the dc output of said motor regeneration power conversion section, and was set up beforehand. Moreover, instead of said constant current control section, it connects with the dc output of said motor regeneration power conversion section, and the above-mentioned purpose is attained also by preparing the regeneration resistance section which carries out a connection change by the delayed relay, combining two or more power regeneration resistance gradually.

[0008]

[Embodiment of the Invention] Drawing 1 makes the first example of this invention correspond to drawing 5 , and shows it. This example controls the braking current of a servo motor 7 by the current regulator circuit which consists of a transistor 11, resistance 9, 12, and 13, and zener diode 10 to the value set up beforehand instead of the dynamic brake resistance 6 in the conventional inverter control device shown in drawing 5 .

[0009] The principle of operation of this circuit is as follows. In the condition other than an emergency stop, the contact 5 for dynamic brake is in an open condition. For this reason, a current regulator circuit does not operate. Next, if an emergency stop command is outputted, while separating a smoothing capacitor 2 and an inverter 1 electrically with the means which is not illustrated, the above-mentioned contact 5 for dynamic brake will be in a closed state, and after the alternating current power revived from a servo motor 7 is changed into direct current power in a diode bridge 8, it is consumed in a current regulator circuit.

[0010] Here, a different point from the conventional control unit is as follows. Although it decreases exponentially as the current ib which flows to the dynamic brake resistance 6 conventionally is shown by several 1 and drawing 6 (A), in this control device, the fixed current decided by the difference of the zener voltage of zener diode 10 and the electrical potential difference between base-emitters of PNP transistor 11 and the resistance of resistance 9 flows. Therefore, the output torque of a servo motor 7 becomes fixed, and since it decreases linearly as shown in drawing 2 (B), the rotational frequency N can shorten sharply the **** distance D of the servo motor 7 after an emergency stop command is outputted until it stops as compared with the conventional control unit.

[0011] Moreover, drawing 3 is made to correspond to drawing 5 , and the 2nd example of this invention is shown in it. This example is connected to the dynamic brake resistance 6 from which resistance differs, respectively, 6-1, and 6-2 in the conventional servo motor control device shown in drawing 5 , after an emergency stop command is outputted, the contact 5-1 for dynamic brake will be in a closed state after time amount t1 progress, and then, the contact 5-2 for dynamic brake will be in a closed state after time amount t2 progress. Consequently, the rotational frequency N of the Current ib and the servo motor 7 which flow to the dynamic brake resistance 6, 6-1, and 6-2 decreases like the thick wire shown in drawing 4 (A) and (B), respectively.

[0012] In addition, the above-mentioned contact 5-1 for dynamic brake and the timing time amount t1 and t2 which makes 5-2 a closed state The current which flows to the dynamic brake resistance 6-1 and 6-2 with the current detection equipment which detects the timer circuit which is not illustrated and the current which flows to a servo motor 7, and which is not illustrated is detected. When it becomes below a certain defined level, the above-mentioned contact 5-1 for dynamic brake and a means to make 5-2 into a closed state can be considered. Thus, according to the 2nd example, the **** distance D of a servo motor 7 can be shortened rather than the conventional example.

[0013] In addition, although **** explained the servo motor, it is applicable similarly about other motors. Moreover, the contact for dynamic brake may be an electronic switching circuit also in Mechanical contacts, such as a relay.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the circuit diagram showing the 1st example of this invention.
[Drawing 2] It is drawing showing the example of a property of the rotational frequency (this drawing (B)) of the current (this drawing (A)) and servo motor which flow to the resistance for brakes by the 1st example of this invention.
[Drawing 3] It is the circuit diagram showing the 2nd example of this invention.
[Drawing 4] It is drawing showing the example of a property of the rotational frequency (this drawing (B)) of the current (this drawing (A)) and servo motor which flow to the resistance for brakes by the 2nd example of this invention.
[Drawing 5] It is the circuit diagram showing the conventional example.
[Drawing 6] It is drawing showing the example of a property of the rotational frequency (this drawing (B)) of the current (this drawing (A)) and servo motor which flow to the resistance for brakes by the conventional example.
[Description of Notations]
1 Inverter
2 Smoothing Capacitor
3 Diode Bridge
4 Three-phase-Alternating-Current Power Source
5, 5-1, 5-2 Contact for dynamic brake
6, 6-1, 6-2 Resistance for dynamic brake
7 Servo Motor
8 Diode Bridge
9, 12, 13 Resistance
10 Zener Diode
11 PNP Transistor

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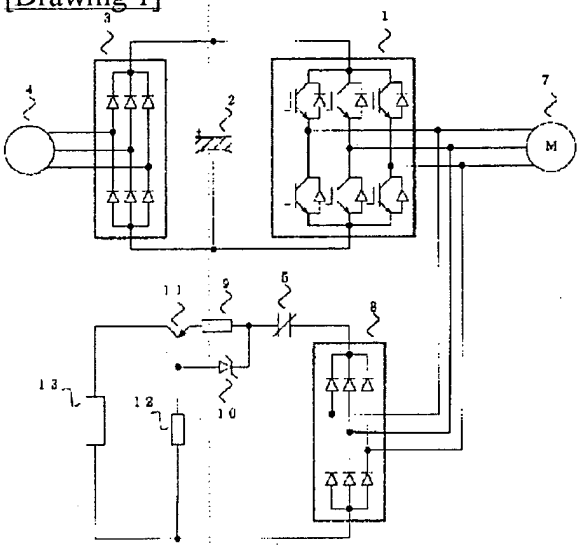
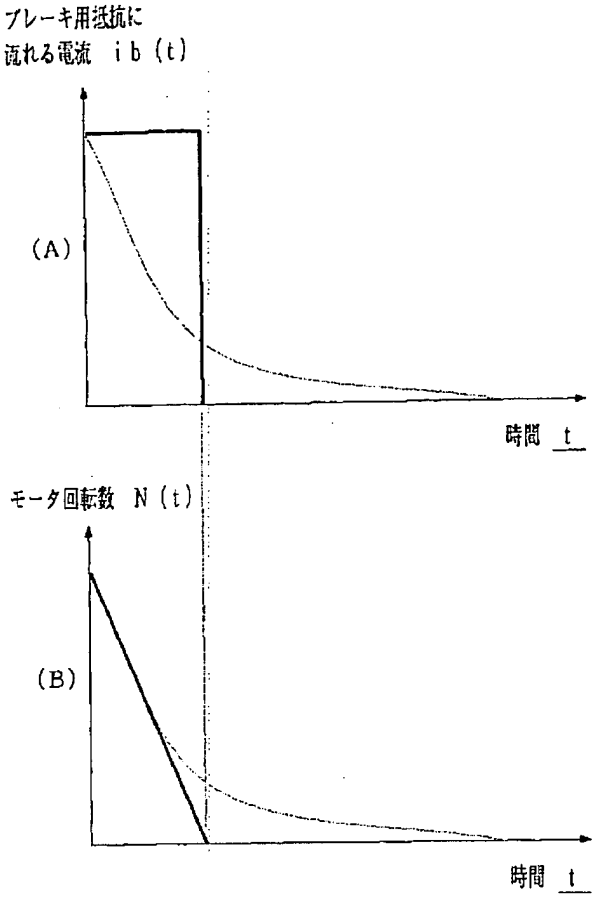
DRAWINGS

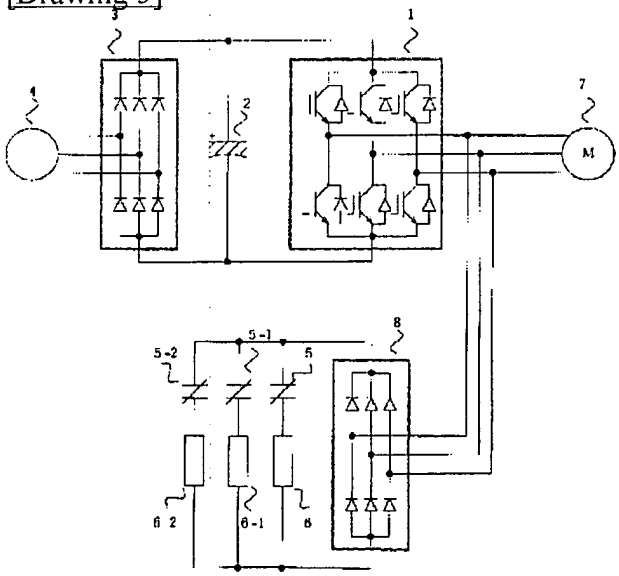
[Drawing 1]



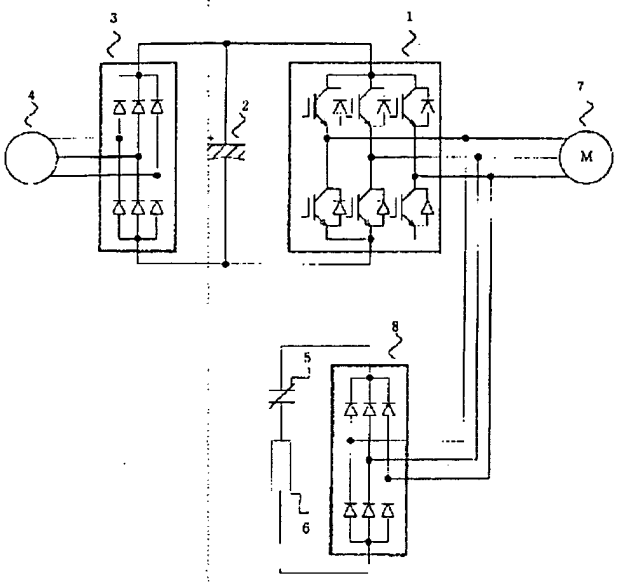
[Drawing 2]



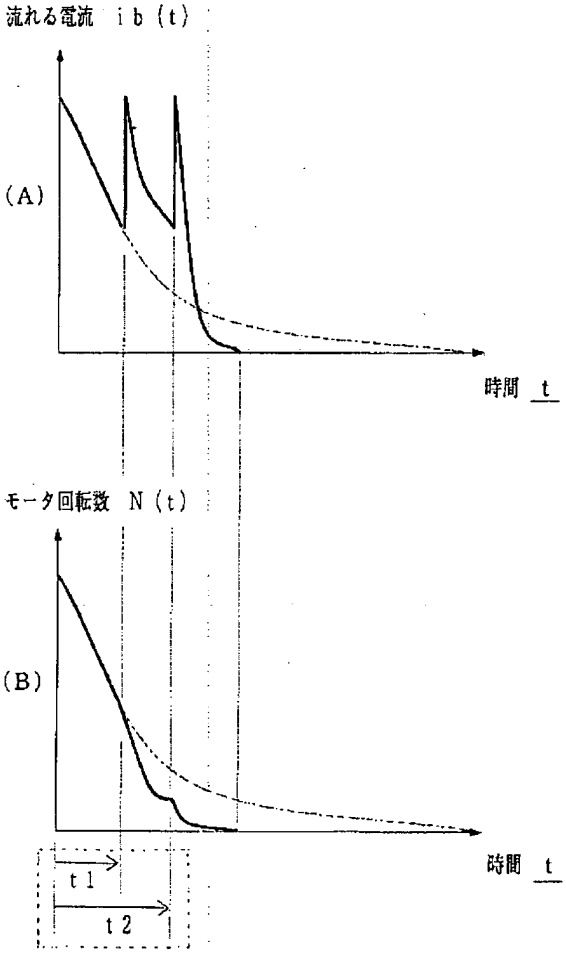
[Drawing 3]



[Drawing 5]

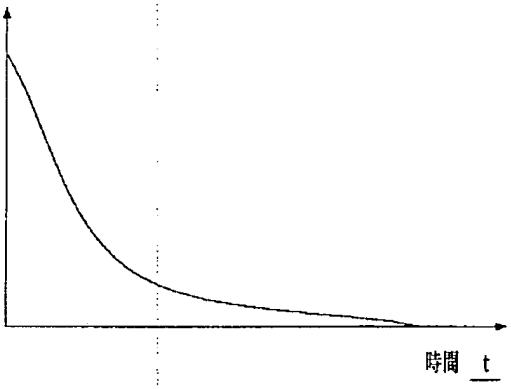


[Drawing 4]

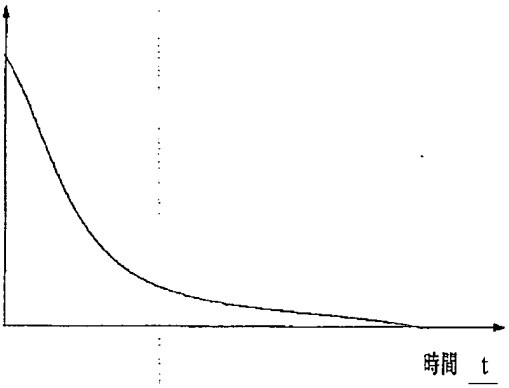


[Drawing 6]

ブレーキ用抵抗に
流れる電流　ｉｂ（ｔ）



モータ回転数　Ｎ（ｔ）



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CLAIMS

[Claim(s)]
[Claim 1] While separating the DC-power-supply section which supplies direct current power to an inverter from said inverter in the regenerative-control circuit which performs power control at the time of moderation of the inverter control device which carries out variable speed control of the motor The inverter control unit characterized by providing the motor regeneration power conversion section which changes into a direct current the alternating current power revived from said motor, and the constant current control section which carries out energization control according to the direct-current constant current which was connected to the dc output of said motor regeneration power conversion section, and was set up beforehand.
[Claim 2] While separating the DC-power-supply section which supplies direct current power to an inverter from said inverter in the regenerative-control circuit which performs power control at the time of moderation of the inverter control device which carries out variable speed control of the motor The motor regeneration power conversion section which changes into a direct current the alternating current power revived from said motor, The inverter control unit characterized by providing the regeneration resistance section which is connected to the dc output of said motor regeneration power conversion section, and carries out a connection change by the delayed relay, combining two or more power regeneration resistance gradually.

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TECHNICAL FIELD

[Field of the Invention] This invention carries out adjustable control of the motor, and relates to the control device in the case of carrying out the emergency stop especially of the servo motor about the inverter control device used for a machine tool, a robot, etc.

[Translation done.]

PRIOR ART

[Description of the Prior Art] Drawing 5 shows an example of the conventional inverter control unit. this example -- setting -- 1 -- for a diode bridge and 4, as for the contact for dynamic brake of B contact structure, and 6, a three-phase-alternating-current power source and 5 are [a smoothing capacitor, and 3 and 8 / an inverter and 2 / dynamic brake resistance and 7] servo motors. Moreover, although not illustrated, it lets the device of a gear, a ball screw, etc. pass to a servo motor 7, and the table of a machine tool, a robot's arm, etc. are connected with it.

[0003] In order to rotate a servo motor 7 from a idle state, power is supplied to a servo motor 7 through an inverter 1 from a smoothing capacitor 2. On the contrary, in order to stop a servo motor 7 from a rotation condition, power is revived from a servo motor 7 to a smoothing capacitor 2 through an inverter 1. At this time, the contact 5 for dynamic brake is in an open condition.

[0004] When carrying out the emergency stop of the servo motor 7, while separating a smoothing capacitor 2 and an inverter 1 electrically with the means which is not illustrated here, the contact 5 for dynamic brake is made into a closed state, a servo motor 7, a diode bridge 8, and the dynamic brake resistance 6 are connected, after changing into direct current power the alternating current power revived from a servo motor 7 in a diode bridge 8, by the dynamic brake resistance 6, it changes into heat, and consumes, and a servo motor 7 is stopped.

[0005] In the above conventional inverter control devices, when carrying out the emergency stop of the servo motor 7, the rotational frequency N (t) of the Current ib (t) and the servo motor 7 which flow to the dynamic brake resistance 6, and the **** distance D are expressed by the approximate expression shown in the one following, several 2, and several 3, respectively.

[Equation 1] ib(t) =KvxN(t) xe(-60 KvKtxt/(2piJR))/R -- [Equation 2] N(t) =Nxe (-60 KvKtxt/(2piJR))/60 -- [Equation 3] D=(N/60) x (2piJR/(60KvKt))

However, for a motor rating rotational frequency and Kv, an induced voltage constant and Kt are [N / Rota inertia + motor shaft conversion load inertia and R of a torque constant and J] root3x (internal resistance + dynamic brake resistance of a motor).

Here, it will be set to (A) of drawing 6 , and (B) if several 1 and several 2 relation is illustrated. As shown in several 1 and drawing 6 (A), in order that the current ib which flows to the dynamic brake resistance 6 may decrease exponentially, the engine speed N of a servo motor 7 decreases exponentially, consequently the phenomenon stopped across the location which must carry out an emergency stop generates a servo motor 7.

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EFFECT OF THE INVENTION

[Effect of the Invention] Conventionally, when the emergency stop of the servo motor was carried out, in order that the rate and speed electromotive force of a servo motor might decrease exponentially, the braking current which flows to dynamic brake resistance also decreased exponentially, as a result, the **** distance of a servo motor became long, but since according to this invention it controls so that the braking current which flows to dynamic brake resistance becomes fixed, the rate of a servo motor decreases linearly and the **** distance of a servo motor can be shortened.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] in a Prior art, since [to which the rate of a servo motor 7 decreases] it was alike, and it followed and the speed electromotive force of a servo motor 7 also declined, the braking current which flows to the dynamic brake resistance 6 could not be kept constant, consequently there was a problem that the brake stopping distance of a servo motor 7 became long. This invention is made from the above situations, and it is alike, therefore the speed electromotive force of a servo motor 7 also declines, and since the purpose of this invention cannot keep constant the braking current whose rate of a servo motor 7 decreases and which flows to the dynamic brake resistance 6, it is to offer the means for solving the problem that the brake stopping distance of a servo motor 7 becomes long.

[Translation done.]

PAT-NO: JP411206184A

DOCUMENT-IDENTIFIER: JP 11206184 A

TITLE: INVERTER CONTROL EQUIPMENT

PUBN-DATE: July 30, 1999

INVENTOR-INFORMATION:

NAME	COUNTRY
ADACHI, MITSUAKI	N/A
MORI, KOJI	N/A

ASSIGNEE-INFORMATION:

NAME	COUNTRY
OKUMA CORP	N/A

APPL-NO: JP10007740

APPL-DATE: January 19, 1998

INT-CL (IPC): H02P007/63, H02M007/797 , H02P003/18 , H02P003/22 , H02P005/41

ABSTRACT:

PROBLEM TO BE SOLVED: To linearly decrease speed of a servomotor and reduce
a damping distance, by installing a previously set constant current control
part in a DC output of a motor regenerative power conversion part, which
isolates a DC power source part from an inverter and converts AC power
regenerated from a motor to DC power.

SOLUTION: This inverter control equipment consists of an inverter 1, a
smoothing capacitor 2, diode bridges 3, 8, a three-phase AC power source 4, a
contact 5 for break, a servomotor 7 and a constant current circuit constituted

of a transistor 11, resistors 9, 12, 13 and a Zener diode 10. A control current of the servomotor 7 is controlled to be a previously set value of the constant current circuit. In the case except emergency brake, the contact is opened and the constant current circuit does not operate. In the case of emergency break, the smoothing capacitor 2 is isolated from the inverter 1, and the contact is closed. Regenerated AC power is converted to DC power by the bridge 8, consumed in the constant current circuit, and the number of revolution of the motor 7 is linearly decreased.

DERWENT-ACC-NO: 1999-486233

DERWENT-WEEK: 199941

TITLE: Inverter control apparatus for controlling rotation of motor used for e.g. machine tool and robot - has constant-current controller connected to output of diode bridge which rectifies AC electric power revived from motor, to perform energizing control by constant DC current

PATENT-ASSIGNEE: OKUMA CORP[OKUM]

PRIORITY-DATA: 1998JP-0007740 (January 19, 1998)

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN-IPC
JP 11206184 A	July 30, 1999	N/A	005	H02P 007/63

APPLICATION-DATA:

PUB-NO	APPL-DESCRIPTOR	APPL-NO	APPL-DATE
JP 11206184A	N/A	1998JP-0007740	January 19, 1998

INT-CL (IPC): H02M007/797, H02P003/18 , H02P003/22 , H02P005/41 ,
H02P007/63

ABSTRACTED-PUB-NO: JP 11206184A

BASIC-ABSTRACT:

NOVELTY - A regenerative-control circuit performs electric-power control during
slowing down of the apparatus. DC power is supplied to the inverter (1) by a
DC power supply made detachable from the inverter. A diode bridge (8) converts
the AC power revived from the motor to DC power. A constant-current controller
connected to the output of the diode bridge, performs energizing

control by a
constant DC current.

USE - For controlling rotation of motor used for e.g. machine tool and robot.

ADVANTAGE - Motor velocity can be reduced linearly since braking current which
flows in dynamic-brake resistor becomes fixed. DESCRIPTION OF DRAWING(S) - The
figure shows a circuit diagram of the inverter control apparatus. (1) Inverter; (8) Diode bridge.

CHOSEN-DRAWING: Dwg.1/6

TITLE-TERMS: INVERTER CONTROL APPARATUS CONTROL ROTATING MOTOR MACHINE TOOL
ROBOT CONSTANT CURRENT CONTROL CONNECT OUTPUT DIODE BRIDGE RECTIFY
AC ELECTRIC POWER MOTOR PERFORMANCE CONTROL CONSTANT DC CURRENT

DERWENT-CLASS: U24 V06 X12 X13

EPI-CODES: U24-D04; U24-D05; V06-N03; V06-N06; X12-J04; X12-J05; X13-F02;

X13-F03B; X13-G01B1A;

SECONDARY-ACC-NO:

Non-CPI Secondary Accession Numbers: N1999-363262